# Everett to Blaine Commuter Rail Preliminary Feasibility Study

## Technical Memorandum #2 – Trackway Facility Constraints

Prepared for the
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by
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# Technical Memorandum No. 2 – Trackway Facility Constraints

The purpose of this technical memorandum is to summarize the information gathered through interviews with staff of the Burlington Northern and Santa Fe Railway (BNSF) of the physical condition of the track, overall track capacity, and planned improvements in the segment of track under review for a concept commuter rail service between Everett and Blaine on the BNSF mainline. The objective of the overall study is to complete a preliminary feasibility analysis of ridership, station sites, and system constraints.

This analysis assumes that freight rail operations will continue in this corridor into the future. Members of the project's Technical Advisory Committee have suggested that some freight rail traffic could be re-routed to the BNSF's Sumas line (north of Burlington up to Sumas), however, the number of trains that could use this line is unknown.

Other technical memoranda being produced for the Everett to Blaine Commuter Rail Preliminary Feasibility Study include:

?? Technical Memorandum No. 1 – Station Site Evaluation
?? Technical Memorandum No. 3 – Ridership Estimation

## Introduction

The rail corridor segment under study is between Everett and Blaine on the BNSF Pacific Division, Bellingham Subdivision. At Everett, the corridor study area begins at the intersection of the BNSF's Scenic and Bellingham Subdivisions, known as P.A. Junction, which is near the city of Everett's multi-modal facility. The Bellingham Subdivision runs south for approximately a half-mile where it turns north under Interstate 5 near 36th Avenue, and winds along the Snohomish River to BNSF's Delta Yard. Delta Yard is the main switching yard for general merchandise business north of Seattle. The mainline segment here, which is referred to as Rogers Main, runs along the east side Delta Yard to Delta Junction. At Delta Junction, the Bellingham Subdivision intersects with the Bayside Spur. Bayside Spur is the track running along the west side of downtown Everett. Bellingham Subdivision runs north from Delta Junction to the US/Canadian border.

Two rail spurs and one subdivision intersect the Bellingham Subdivision between Everett and Blaine, WA:

- Anacortes Spur intersects the Bellingham Subdivision at Burlington and runs out to the refineries at Fidalgo.
- Cherry Point Spur intersects the Bellingham Subdivision at Intalco, near Custer and runs out to the west to Cherry Point.
- Sumas Subdivision intersects the Bellingham Subdivision at Burlington and runs north to Sumas near the US/Canadian border.

## Physical Characteristics and Condition

The physical characteristics of the existing BNSF track that are of primary importance in this analysis are listed below:

- Sidings
  - Length
  - Size of turnouts off the mainline (No. 20 turnout speed 40 mph, No. 11 turnout speed 15 mph)
  - Distance between
- Track curvature
  - Number of curves
  - Average degree of curve
  - Maximum degree of curve
- Track profile
  - Maximum (ruling) grade
- Grade Crossings
  - Number of crossings by type
    - Public/Private
    - Overpass/Underpass/At-grade
    - Vehicle/Pedestrian
- Rail and ties
- Signal system
- Operations
  - Train sizes
  - Number of trains
  - Types of Traffic

### Sidings

The existing track sidings in the study area are shown in Table 1.

**Table 1**
**Characteristics of Siding Tracks in the**
**Everett to Blain Rail Corridor**

| Location | Milepost | Length (ft) | Turnout Size | Distance to Previous Siding |
|---|---|---|---|---|
| Everett | 0.0 | | | |
| Marysville | 38.8 | 2,557 | | |
| English | 45.5 | 6,846 | 20 | 6.7 |
| Stanwood | 55.5 | 6,381 | 20 | |
| Mt. Vernon | 66.8 | 6,075 | 20 | 11.3 |
| Burlington | 71.9 | 4,635 | 11 | 5.1 |
| Bow | 79.7 | 8,884 | 20 | 7.8 |
| South Bellingham | 92.9 | 6,347 | 20 | 13.2 |
| Ferndale | 106.3 | 8,478 | 20 | 13.4 |
| Swift | 116.4 | 8,588 | 20 | 10.1 |
| Blaine | 119.3 | 6,060 | 11 | 2.9 |
| Max. Length (ft.) | | 8,588 | | |
| Average Length (ft.) | | 5,896 | | |
| Avg. Dist. Bet. Sidings (miles) | 8.9 | | | |

## Track Curvature

The track alignment includes 92 curves over the rail corridor. The maximum curvature limits the track speeds to 15 mph between P.A. Junction and Delta Junction, and 20 mph between 96.7 and 97.5 between the north end of the Georgia Pacific plant to a point approximately 1/3 of a mile north of the BNSF depot in Bellingham.

## Track Profile

The track profile is relatively flat over the rail corridor. The maximum grade traveling north from Everett to Bellingham is 0.5 percent. North of Bellingham is a stretch of track with a grade of 1.09 percent. The maximum grade traveling south from Bellingham to Everett is 0.6 percent. North of Bellingham is a stretch of track with a grade of 2.88 percent.

## Grade Crossings

The number grade crossings within the study area by type are shown in Table 2.

**Table 2**
**Grade Crossings Locations in the Everett to Blaine Rail Corridor**

| Type | Number | Locations |
|---|---|---|
| Pedestrian at-grade | 2 | Bellingham, Ferndale |
| Pedestrian overpass | 2 | Bellingham |
| Public at-grade | 131 | Various |
| Public overpass | 15 | Various |
| Public underpass | 8 | Various |
| Private at-grade | 82 | Various |
| Private overpass | 1 | Everett |
| Private underpass | 4 | Stanwood, Burlington |

## Rail and Ties

The track in the study area consists primarily of wood ties. The rail used on the track between Everett and Custer (Intalco) is primarily 132-pound or 136-pound continuously welded rail. Between Everett and Custer 115-pound bolted rail is in place in a few short pieces, and entirely between Custer and Blaine.

## Signal System

The signal system in the study area is Centralized Traffic Control except the segment between MP 93.5 and 98.7 in Bellingham, which is under an Automatic Block System. A brief description of Centralized Traffic Control and Automatic Block Systems is included in the Glossary.

## Operations

The density of track over the corridor changes at two locations. South of Custer (Intalco), the volume of rail track is 50 percent greater than it is to the north. This accounts for the rail traffic generated to and from the Cherry Point branch line. At Burlington, the traffic volume is 12 percent greater than demand to the north because of the rail traffic traveling to and from the Sumas and Anacortes branch lines.

### Average Train Size

The average train size for passenger trains (one Amtrak) is 700 feet, while the average train size for freight trains is 5,250 feet, with $90^{th}$ percentile size at 6,480 feet. The $90^{th}$ percentile train size is the train length used for line capacity analysis.

### Average Number of Trains

BNSF is currently averaging 14 one-way trains per day over this route, with peak days at 18 trains. Four trains (two round-trips) per day are Amtrak between Bellingham and Everett, with two of those trains continuing north between Bellingham and Vancouver, BC; the others are freight trains.

### Traffic

Rail traffic on this line includes very time-sensitive passenger trains, merchandise and Rabanco Garbage trains that are time-sensitive to varying degrees, and unit trains carrying coal, soda ash and potash.

## Corridor Capacity

In order to convey the factors that may influence and drive rail transportation within the region, the existing system must first be analyzed. The primary driver in any rail system is line capacity. Line capacity is basic operating capacity of a segment of railroad track. The train movements on any segment of track are dependent upon the speed of trains and the distance between them. The speed of the train is dependent upon the ratio of horsepower to gross tonnage (trailing tons) and the grades, curves, and other features encountered by the train. The distance between trains is dependent upon the length and number of signal blocks used to space trains within single and double track territory under single direction operation; the ruling grade is the steepest gradient encountered along the route under construction.

One element of the corridor capacity equation is a function of the average freight train lengths as follows:

A. 5,000-, 5,500-, 6,000-foot train lengths

   At 5,000- through 6,000-foot train lengths, the limiting capacity of this corridor is 31 trains, with the restricting segment between Everett to English. The next limiting capacity is 39 trains, on the Ferndale to Blaine segment. The Everett to English segment is restricting because of the lack of any sidings long enough to meet trains on. The Ferndale to Blaine segment is restricted because of the conflict of mainline traffic with switching operations to and from the Cherry Point Spur at Custer.

B. 6,500-foot train lengths

   At 6,500-foot train lengths, the limiting capacity of this line is 23 trains. The additional restricting segments are English to Bow, and Bow to Ferndale (both with capacity for 23 daily trains). The next limiting capacity is 31 trains, on the Everett to English segment. The English to Bow and Bow to Ferndale segment is restricted because of:

   1) Lack of sidings to accommodate 6,500-foot long trains.
   2) Yard switching and mainline conflicts at Burlington.
   3) Speed restrictions through Bellingham.

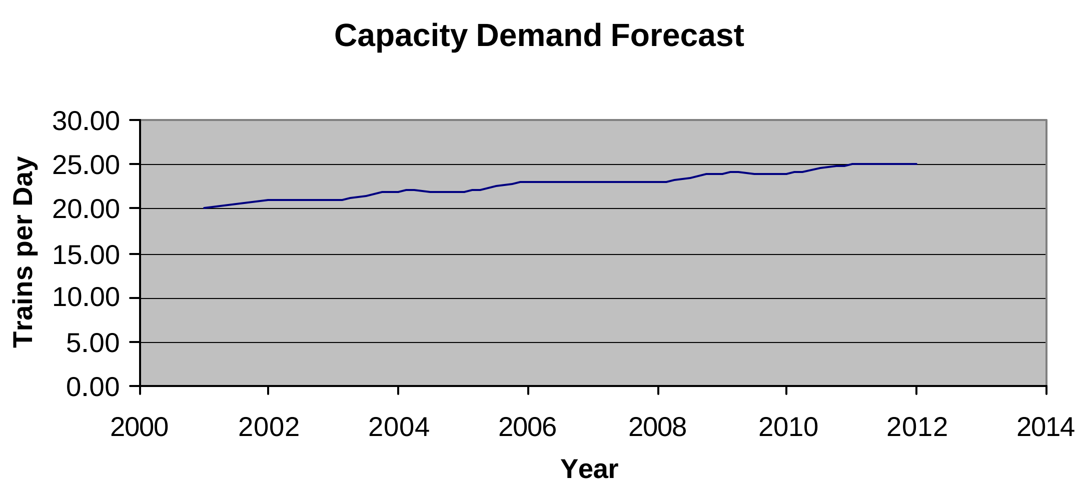
Bow, along with Ferndale and English, are the only sidings long enough to meet a 6,500-foot long train within this corridor. The distance between English and Bow is 34.2 miles. The switching and mainline conflicts are further complicated by the train operations on and off the Sumas Subdivision and Anacortes Spur. The mainline at Bellingham winds along the Puget Sound through the Georgia Pacific at a permanent speed restriction of 20 mph.

## Future Capacity Demands

In order to estimate future capacity demands, the following annual growth rate by traffic type was used. These values are often used by the industry for future demand predictions.

- **Manifest (2 percent)** – will grow at a rate similar to Gross National Product (GNP) or Industrial Products Index (IPI).
- **Intermodal (3 percent)** – will grow at a faster pace than Manifest and Unit but is more likely to have big swings as shipping lines move to other ports.
- **Unit (2 percent)** – such as grain, soda ash, potash, depends on foreign markets and foreign harvests.

**Exhibit 1**
**Estimate Future Daily Train Demand**
**Between Everett and Blaine**




*Source: Discussion with Gary Agnew, BNSF, May 2001*

Exhibit 1 depicts growth in trains per day across the route given the current trains per day, traffic split, and forecast growth. Also shown on the chart is the maximum practical capacity for the line. The predictions assume two additional Amtrak trains per day and no changes in operations or capital improvements that affect the line's capacity. The capacity will be exceeded in 2006.

## Increasing Line Capacity

Increasing line capacity falls into two categories: increasing the speed of trains; or decreasing the distance between trains. Line modifications or changes in the horsepower to gross tonnage ratio will also affect the speed of the trains. Changes in the location of sidings and/or changes to the signal system will affect the spacing of trains. There are a number of ways to achieve increase capacity as described below:

### Identification of Constrained Segments

Identification of segments that have mainline capacity constraints is accomplished using sophisticated railroad transportation performance measurement systems and computer modeling. Typically, the transportation performance measurement systems used to identify those trains which are failing to make their planned running time over segments of track or are delayed for lengthy periods of time waiting to meet or pass other trains. Computer modeling is used to determine the base case running time for trains given sets of locomotive power, car type, tonnage, and length. These tools pinpoint the root cause of the mainline capacity constraint and are used by management in determining the best course of action.

### Adequate Locomotive Equipment

Each train has a service plan that specifies for each segment of the trip the running times, tonnage and length restrictions, and required locomotive horsepower per trailing ton (HP/TT).

Historically, not having proper locomotive horsepower on trains has contributed to mainline capacity constraints. Allocating the proper locomotive horsepower to trains is a simple solution to underpowered trains. However, the logistics of having a sufficient number of locomotives at the right place at the right time is complicated. The locomotive distribution process must provide power to many different trains throughout the entire railroad network, respond whenever a locomotive fails en route, and perform locomotive scheduled maintenance, all while maintaining high utilization.

### Adjust Train Schedules

Trains do not run steady throughout the entire day. This unsteady flow creates peak demands for limited line capacity which ultimately contributes to the under utilization of the line. The railroad uses "stringline" tools to map all the trains on a territory as they progress over the course of the day. This tool identifies where trains are scheduled to meet or pass other trains and available slots in the day where trains could be moved to reduce the peak demand for line capacity. However, modifying the schedule of one train can leave a ripple effect in yard utilization, locomotive utilization, shipper's needs, etc.

### Change Operating Practices

Changing operating practices is the next step toward increasing line capacity. Some examples include running longer trains, use of distributed power, or use of helper service. Distributed power and helper services are methods to supplement the engine power and increase average train speeds.

### Make Capital Investment

The least desirable choice to add mainline capacity is through capital investment because this type of expenditure cannot be re-allocated should demand diminish or shift. The types of capital investments include upgraded signal systems, better vertical or horizontal alignment, and additional track. Track additions include new or lengthened sidings, additional mainline tracks, or track crossovers. These improvements are designed to add mainline capacity by decreasing the spacing between trains and increase dispatching efficiency at strategic locations. Acquiring additional locomotives and rail car equipment is also considered a capital investment. Railroads are increasing the purchases of newer and more reliable locomotives while minimizing capital investment in railcar purchases by focusing on cycle-time efficiency.

## Planned Corridor Improvements

The following projects are included in the *Amtrak Cascades Plan for Washington State*[1] report. These projects increase available capacity in the corridor, which in some cases will lead to allowable increases in train speeds. The four projects, which are either complete, under construction or in the design and planning stages, are being progressed as part of the improvements required to implement new Amtrak service between Seattle and Vancouver. That is, these projects are designed to provide capacity enhancements for increased Amtrak service, and may not provide any capacity for commuter rail operations. Enhancements for commuter rail service would need to be evaluated and negotiated with BNSF.

?? **Burlington** – 1.7-mile mainline realignment to accommodate increased Amtrak service between Seattle and Vancouver, B.C. This project separates the switching operation and Burlington Yard and the Anacortes connection from mainline freight and Amtrak operations. The project was completed July 2001.

?? **Custer** – 1.1-mile mainline realignment to accommodate increased Amtrak service between Seattle and Vancouver, B.C. This project separates the Intalco switching operation from mainline freight and Amtrak operations. The project is under construction and is scheduled for completion September 2001.

?? **English** – 0.6-mile siding extension to accommodate increased Amtrak service between Seattle and Vancouver, B.C. The project will create a train meet and Everett terminal hold out track to facilitate freight operations and thereby accommodate an additional Amtrak train. The project is under design.

?? **Bellingham** – 0.8-mile mainline realignment to accommodate increased Amtrak service between Seattle and Vancouver, B.C. This project separates the Georgia Pacific plant switching operation from mainline freight and Amtrak operations. The project is in conceptual design and is presently on hold.

[1] Washington State Department of Transportation Rail Office, prepared by The Resource Group in association with HDR Engineering and Triangle Associates, 4/2000.

# Glossary

## Automatic Block System (ABS)

ABS divides the track into blocks, with a signal at the limit of each block. The signal automatically detects the presence of a train in the block by way of electronic circuitry that includes rail on the track in the block. ABS not only reports on the condition of the block immediately ahead, but also the condition of the next one or more blocks beyond. The engineer is always warned of the need to stop at a sufficient distance from the stop. Unless a signal indicates that the speed must be changed to enable stopping at a red signal or that a stop is required at the next signal, normal speed may be maintained.

## Centralized Traffic Control (CTC)

CTC is a system arranged so that the dispatcher controls the throwing of switches and the clearing of signals for train operation by signal indication. A train may occupy a main track in CTC territory if it has been permitted to do so by signal indication. This means, that a train may enter a CTC track from another track, or move within the CTC territory, on signal indication alone. A signal indicating it is safe to proceed is thus the authority to proceed. A CTC track can be used for traffic in both directions, though one direction may be preferred in daily operations.

Signals in CTC territory are a mixture of controlled and automatic signals. Controlled signals protect mainly dual control switches and are controlled by an interlocking and are under direct control by the dispatcher. A CTC interlocking location is often referred to as a Control Point (CP). The most restrictive indication from a controlled signal is “Stop,” since proceeding past the signal may mean entering directly into another train’s route.

Controlled sections are the sections of main track between the control point locations. These sections are generally between a few thousand feet long and several miles long. As many trains moving in the same direction that fit in the section may occupy each section. Normally, the section cannot be occupied by trains moving in the opposite direction. Once two or more trains are in a section, following trains cannot pass the train ahead until the next control location is reached.

Generally, the time required for a train to run from one control point location to the next is a significant factor in the capacity and reliability of a rail line. The time it takes to travel between a control location is also the amount of time that each controlled section is occupied and unavailable for other trains.

Automatic signals are found on the line between control points. The dispatcher cannot directly control the signals. Automatic signals normally display “Stop then Proceed” as their most restrictive aspect. Thus, an automatic signal in CTC territory will always authorize a train to continue.

Any train needs to have some sort of permission to occupy a main track. The required permission depends on the type of operation in effect for that main track. The type of operation of any main track is listed in the employee timetable, as explained below.